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Cincinnati, Ohio

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Presented at the Air Pollution session of the annual meeting of the American Industrial Hygiene Association, St. Louis, Missouri, April 25, 1957.

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HEALTH, EDUCATION, AND WELFARE

Public Health Service
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METHODOLOGY FOR EVALUATING THE AIR POLLUTION PROBLEMS OF A STATE

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Realizing that pollution of the atmosphere by domestic, industrial and agricultural activities is becoming an ever-increasing environmental problem, some states have recognized the need to assess their current and potential air pollution problems in order to inaugurate prevention and control activities without delay. In some instances, states have sought the assistance of the Federal Government which is available and which has been offered through the program established by Public Law 159 of the 84th Congress. This program is being administered by the Public Health Service.

The methods described here were developed and used in three state-wide air pollution appraisals in Connecticut, Washington, and Tennessee respectively during the past 12 months and will shortly be put to use in a fourth such study in Texas. All four studies have been, or, in the case of Texas, will be, cooperative studies conducted jointly by members of the staffs of the state health departments and the State and Community Services Section, Community Air Pollution Program, Public Health Service.

(1) Mr. Keagy, Sanitary Engineer, and Mr. Kenline, Assistant Sanitary Engineer are attached to the State & Community Services Section, Community Air Pollution Program, Public Health Service.

(2) Dr. Hendrickson, Associate Research Professor, and Mr. McCaldin, Sanitary Engineer (PHS), are located in the Department of Sanitary Engineering, University of Florida.

Objective and Scope

The objective of a state-wide appraisal should be to assess present and potential air pollution problems and to secure data from which the state can determine the need and scope of a future program or activity.

The scope of a state-wide appraisal can range anywhere from a brief reconnaissance based on visual observations to a detailed study including air sampling and analysis extending over a period of several years. The methodology herein reported is intermediate between these two approaches in that it does not include air sampling and analysis but extensively and intensively exploits all existent data in the state relevant to the air pollution problem. Until detailed information is obtained relative to existing sources and the compounds which may be involved in the emissions therefrom, it is nearly impossible to know what pollutants for which one should sample. The procedures which have proven useful in obtaining this data have included questionnaires, interviews, visual observation, review of material in libraries and office files, estimation, and computation based thereon. This approach required about one man-year of effort for each of the three state studies mentioned earlier. Such a study can be a one-man operation but preferably it should have a minimum of two men and a secretary.

It is almost impossible to set forth a time table which would be adaptable to any state-wide survey. There are many variables and considerations. However, there are four distinct, time-consuming phases of a study of this type which should be noted:

1. The "arranging-for-the-study" phase. This is the period when the cooperating agencies or persons communicate, formally or informally, and make the necessary arrangements

for personnel, policy, money and facilities.

2. The "orientation-of-the-investigators" phase. The length of time needed for this phase is of course dependent upon the investigators' knowledge of and familiarity with the state and the problem.

3. The "gathering-the-information" phase. Proximity to the sources of information and the number of cities to be visited are probably the principal factors in the length of time required for this phase.

4. The "report-writing" phase. It is assumed that study and analysis of the data will be done during the course of these latter two phases and, therefore, report writing is not a distinct part of the time table. Two factors greatly affect the time required, the amount of review and clearance required, and the form of the final report.

Types of Data Needed

Since all state surveys to date have involved health departments, it has been necessary first to agree that, despite the usual limitation of health department activity to that which directly affects public health (as interpreted in its broadest sense), an air pollution appraisal to be of any real value must embrace an even wider area of interest. It must explore the effect of air pollution which has been defined as the presence in the atmosphere of substances, put there by the acts of man, in concentrations sufficient to interfere with his comfort, safety, and health or with the full use and enjoyment of his property. This definition was used in the recent studies and is widely accepted today. It recognizes the need for inclusion in the appraisal of studies of plant, livestock

and material damage, studies of problems associated with visibility reduction, and problems associated with non-disease-producing attacks of air contaminants on our senses and our attitudes. It further recognizes that the atmosphere is self-cleaning and that a certain amount of impurity in the air can be tolerated without the creation of an air pollution problem.

The types of data needed for assessing past and current problems, therefore, include:

Complaints by the public
Evidence of damage
Results of sampling activities
Opinions and experiences of individuals
Emission data
Climatological and meteorological data and analyses

For estimating the potential problem, additional information is needed on:

Population density and growth trends
Industrial density and growth trends
Fuel use patterns and trends
Topographical data and maps
Refuse disposal practices
Agricultural practices
Transportation data

The need for data on the emission rates of all types of pollution-causing activities and processes has been recognized, and attention is being directed toward the difficult problem of obtaining the information. It was only partially obtained during the first two surveys (1) (2), but plans call for more comprehensive emission estimates in current and future studies.

The need for information on climatology and topography is apparent; these are the natural factors affecting the pollution potential of any area. Data on trends regarding population and industrial growth, fuel usage, refuse disposal practices, and transportation

practices are significant with respect to the wastes discharged to the atmosphere because they allow us to estimate the degree of the potential problem.

Information regarding agricultural practices and experiences is needed not only for the purpose of estimating economic damage received and caused, but also for possible valuable data that might be found regarding plants as indicators of pollution.

Sources of Data

A list of the possible sources of information and data would be too lengthly for inclusion in this brief report. However, the following list gives some of the information sources found useful in the surveys made thus far:

1. Official and private agencies
2. Public and private officials
3. Published and unpublished data and analyses
4. Field visits by the investigators

Complaint Records

The complaint records of official agencies constitute one of the first places to look for information as to whether or not the public has recognized air pollution as a problem. Records of complaints regarding nuisances from smoke, dust, odor, etc. or regarding damage to plants, animals, paint, etc. may be found in a number of offices. They are submitted to the mayor or city manager, the city council, the health department, the city clerk, the building department, the police or fire departments, the public works department, the county agricultural agent, and undoubtedly there are records of complaints on file in other offices. For the state as a whole,

complaints are usually filed with the state health department.

If there is no formal air pollution program in the area, action taken on the complaints ranges anywhere from filing them in the waste basket to forwarding them to designated departments or persons for investigation and any action possible under existing laws, ordinances, or regulations.

It is to be noted that the number of complaints filed is not necessarily a measure of the extent or degree of pollution. The number received may be influenced by, among other factors, the attention given to previous complaints, or by the nature of the pollution with respect to whether it is a chronic condition or an acute situation. The public may have learned to live with a chronic condition, but on the other hand, it may flood the city hall with complaints regarding a less serious nuisance which persisted for only a few hours. An examination of complaints will usually reveal which of these two types of pollution was encountered. This knowledge will then serve as a guide to the investigator as to the procedure to follow in his assessment of the air pollution problem of the area.

Interviews With Officials

Another available source of information as to the existence of a recognized problem are the state or local officials themselves. This is especially true where chronic conditions exist for which there are no written complaints on file. Local officials are usually aware of these situations through personal observation or through the receipt of verbal complaints from citizens or groups. The mayor or city manager; the city or county engineer; the local or state health officer or any of his professional staff of engineers, sanitarians and nurses; or the city or county planner are some of the best possible sources of such information. Again, however, discretion

and care must be used in interpreting the findings. In addition to the factors affecting the reliability of recorded complaints, is the possibility that the official may be biased in the matter. In one of the cities studied, the only complaint found was that of a city councilman whose store and home on the outskirts of the city were the only dwellings in the prevailing path of a smoke plume from a factory chimney.

Published and Unpublished Data

The remaining sources of information may be grouped under the broad heading of published and unpublished data on all factors of air pollution. These publications may be public or private and are to be found in such places as the offices of local, state and federal official agencies; in the files of industry and private associations; in the offices and libraries of universities and other research agencies; and in miscellaneous places such as the Chamber of Commerce, the bank, the public library, and the utility companies.

At first glance this gathering of data may seem to be an overwhelming task. Admittedly it is time-consuming to locate and procure these many publications and reports and to glean the desired information from them, but with the knowledge of the type of information being sought, the investigator will find the task by no means endless or frustrating. Usually it is quite obvious where the information can be found. Population information is available at the local office of the Bureau of the Census, and chambers of commerce and universities may also provide pertinent data. The local or state fuel dealer's association is a primary source of information on fuel usage. For meteorological and climatological data, the local Weather Bureau offices are the obvious choice. A search for published or mimeographed reports in regular or office libraries will

disclose much information relative to the number and type of studies which have previously been made; university libraries are usually a good starting point. Questionnaires and interviews may reveal the existence and location of these reports. Very often records of air sampling are a part of the study reports. Dust fall records, sulfur dioxide concentrations, fluoride concentrations, and filter tape data are often available.

Questionnaires

In discussing the methods of obtaining the data, the importance of making early contact with and visits to the agencies and associations which might contribute materially to the success of the study cannot be overemphasized. Such agencies will appreciate an explanation of the purpose, objectives and scope of the study and will usually reward the investigator with their fullest cooperation.

The initial data-gathering activity may well be the designing and mailing of the questionnaire. Questionnaires serve several purposes in addition to the principal one of collecting information and data. When mailed early, they provide information which materially assists in planning or modifying the conduct of the study and they pave the way for later interviews when there are gaps to be filled. They arouse and foster interest in the subject of air pollution. Examples of questionnaires (Figures 1 & 2) used in the several state studies show, without further explanation, the kinds of questions asked and the method of asking them. They should be sent under a transmittal letter from the state health officer, his representative or some such person of authority in the state (Figure 3). The letter should relate the objective and scope of the study and should clearly indicate how the information is to be used. The party receiving the questionnaire thus feels that his

information is needed and will be inclined to furnish more complete answers.

Information secured through the use of the questionnaire must be interpreted with recognition of certain limitations. These include: the degree of objectivity of the questionnaire, the informativeness or bias of the answers, the degree of coverage, and the percentage of questionnaires returned.

Field Visits

Field visits may be initiated as soon as the questionnaires have been mailed. Interviews should, of course, be arranged by appointment and should be brief. Repetitive interviews such as with health officers, city engineers, etc. should be standardized for thorough and efficient analysis of answers. A check sheet or interview data sheet will serve this purpose. The one used during the Connecticut study (Figure 4) is self-explanatory.

These interviews have proven productive and valuable in many respects. Among other things, they assure the public that this is not a swivel-chair survey; like the questionnaires, they foster or arouse interest in the subject; they provide information which fills in the gaps between the questionnaires the studies and the published reports; and they provide leads to additional sources such as informed persons or offices and obscure published or unpublished studies and reports.

Visits to representative areas and to selected locations of special interest complete the list of methods for obtaining information. First-hand observation by the investigator is a "must" where time and travel permit. Although recorded and verbal complaints will probably bring to light many past problems and nearly all present ones, it is probable that the trained eye of the

investigator will detect additional conditions or circumstances worthy of note. Furthermore, it should be recognized that the reader of the final report will be inclined to discount its validity if it is known that the report was written without the author having personally witnessed present emissions or existing damage. Field trips should be so planned that all principal cities and nearly all counties are visited. In the Washington and Tennessee studies the investigators went to all cities of over 10,000 population and to all other communities where a questionnaire return or other source of information indicated existence of an air pollution problem. In Connecticut all cities of over 20,000 were visited. In Washington, trips were scheduled to the county seats of those counties omitted by this procedure.

Results Expected

Despite the fact that no sampling of the ambient air or emission sources is made during the course of the survey, a qualitative determination of the existence and severity of air pollution in the state can be made. Samples are not needed to show that a problem exists if one can observe a pollution pall hanging over a city. The local citizen does not need air sampling data to tell him that visibility is reduced, that his eyes smart, and his clothes get dirty hanging on the line. Maybe he doesn't know the exact element or compound involved, but he does know that he is experiencing the effects of air pollution. He may suspect that "something in the air" is causing damage to his plants and to the finish on his automobile, but extensive, detailed sampling may be required to prove it. If the condition has been serious enough for a relatively long period,

a special study of the problem may have been conducted and the results noted during the course of the state-wide survey. Thus, a survey of this type should discover suspected air pollution problems and the final report should indicate the need for further investigation.

In addition to results which point to obvious and suspected air pollution problems, analysis of the information collected will permit delineation of the geographical distribution of the problem areas. For instance, until it is noted that five cities for example, are influenced by common meteorological and topographical conditions, it may not be recognized that on some days the bulk of the pollution from all five cities is concentrated over one of them. An analysis of these natural factors, along with such factors as population growth and density, fuel usage, etc., permits sounder judgment as to where pollution may be a problem in the near or distant future.

Use of the Results

Survey results may be used in several ways. First, they should be used in the manner intended - to serve as a guide to future state action. Since the investigator should be able to conclude whether air pollution is the cause, or the suspected cause of a problem in specified geographical areas or fields of interest, his conclusions should result in recommendations for prevention, control, or further detailed study.

Any picture of the state situation is a composite of reports on local conditions. Survey results, therefore, should next serve as an assessment and guide not only for state officials but also for local and regional officials. One of the principal observations which such officials can make, is to emphasize the

adequacy of, or the need for control regulations. Adequacy, in this context, must be specified in terms of the measures used in the appraisal rather than in terms of gravimetric or volumetric air analysis.

Finally, one of the most rewarding results of the survey is the fact that they serve as a starting point for any future program or activity which may be initiated. If a representative of the state assists in, or alone conducts the investigation, he becomes familiar with the science of air pollution prevention and control and gains first-hand knowledge of the status and potential of air pollution problems of his state. He will secure much valuable information and data which, although they may not appear in the report, may serve as useful reference or evaluation material at a later date. The results of a survey, then, serve as a guide to state and local officials, as a sound starting point for an active program, and as a base line for future evaluation of the air pollution problems or program of the state.

Conclusion

It is increasingly evident that air pollution problems are experienced wherever there is industrialization and urbanization. Hardly any of the forty-eight states can disclaim a current or potential pollution problem in some area of that state. Therefore, it would seem that each state must eventually make a preliminary assessment of its air pollution situation. It is recognized that each state must tailor its own survey to its particular need and circumstances. However, the methods discussed here should prove useful in planning future appraisals.

STATE OF WASHINGTON DEPARTMENT OF HEALTH
AIR POLLUTION SURVEY QUESTIONNAIRE

July 23, 1956

Please check the appropriate box and provide information for any YES answer briefly on the reverse side or attached sheet.

	YES	NO
1. Are there any operations (municipal, domestic, industrial) in or near your area of jurisdiction that emit noticeable amounts of smoke, fumes, dust, or odor to the atmosphere?	( )	( )
2. In your opinion, are the smoke or other pollutants in sufficient concentration to cause:		
a. Measurable discomfort or inconvenience to residents?	( )	( )
b. Damage to property? (autos, paint, clothing, buildings, etc.)	( )	( )
c. Damage to vegetation? (lawns, crops, flowers, etc.)	( )	( )
3. Have you received complaints of air pollution in which the complainant claims:		
a. Noticeable discomfort or inconvenience?	( )	( )
b. Damage to property?	( )	( )
c. Damage to vegetation?	( )	( )
4. Do any of the problems result from seasonal activities?	( )	( )
5. Are any of the problems the result of seasonal or periodic weather conditions?	( )	( )
6. Are there any local ordinances or regulations for the control of smoke, fumes, dust and odor?	( )	( )
7. Do you know of any activities planned for the future in your area which might contribute to air pollution?	( )	( )
8. Have any steps been taken to assess the local air pollution situation such as surveys, inspections, or investigation of complaints?	( )	( )
9. Are there any other groups (official or unofficial) in your community who might furnish additional information regarding air pollution problems?	( )	( )

Name of individual reporting _____

Name of (fill in one)
City _____
County _____
District _____

Return to: Washington State Health Department, Engineering Division, Smith Tower, Seattle 4, Washington.

FIGURE 1

STATE OF TENNESSEE
DEPARTMENT OF PUBLIC HEALTH

AIR POLLUTION APPRAISAL QUESTIONNAIRE

	YES	NO
1. Are there any operations (municipal, domestic, industrial) in your area of jurisdiction that emit objectionable amounts of smoke, fumes, dust or odor to the atmosphere?	( )	( )
2. In your opinion are these pollutants present in sufficient concentrations to cause:		
a. Discomfort or inconvenience to residents?	( )	( )
b. Damage to property? (autos, paint, clothing, buildings,etc.)	( )	( )
c. Damage to vegetation?	( )	( )
d. Injury to animal life?	( )	( )
3. Has your office received complaints concerning air pollution during the past two years?	( )	( )
4. Are the air pollution problems in your area of jurisdiction principally due to:		
a. Municipal activities (dumps, incinerators, etc.)	( )	( )
b. Domestic activities (incinerators, heating plants, etc.)	( )	( )
c. Commercial activities?	( )	( )
d. Industrial activities?	( )	( )

5. Please describe briefly any air pollution problems in your area of jurisdiction.

_____
_____
_____
_____
_____

6. In your opinion is the problem described above of major ( ) or of minor ( ) significance?

7. Are there any local ordinances or regulations for the control of smoke, fumes, dust or odor?	( )	( )
8. Have any steps been taken in your area of jurisdiction to control sources of air pollution?	( )	( )
9. Are there sources of air pollution outside your area of jurisdiction which have created a problem in your area?	( )	( )

10. Please list any other groups (official or unofficial) in your area of jurisdiction who might furnish additional information regarding air pollution problems.

_____
_____

Return to: Industrial Hygiene Services,
Tennessee Department of Public Health,
Nashville, Tennessee

County: Signed: _____

FIGURE 2

ARTHUR B. LANGLIE
GOVERNOR

BERNARD BUCOVE, M.D., D.P.H.
DIRECTOR

SECTIONS:
SANITARY ENGINEERING
ENVIRONMENTAL SANITATION

STATE OF WASHINGTON

DEPARTMENT OF HEALTH
DIVISION OF
ENGINEERING AND SANITATION
SMITH TOWER
SEATTLE 4

September 10, 1956

To The Management
Manufacturing and Process Industries
State of Washington

Subject: Air Pollution

Dear Sir:

There has been considerable interest shown over the past few years regarding present and potential air pollution problems. The attached Health Department "Statement" explains a study now underway, the purpose of which is to bring into better perspective the actual situation on a state-wide and local or regional basis. It is a fact-finding study and, as indicated in the "Statement", will provide a foundation for the determination of the need for and type of future activity.

Your knowledge and information about your own particular installation can be most helpful and is most essential to us. Accurate industry information is needed so that this source may be placed in its proper perspective in relation to other sources including transportation, domestic activity, agricultural practices, refuse disposal, natural sources, etc. The attached "Industrial Questionnaire" is designed to obtain general information by areas and communities as to types and sizes of industries and the control activities already accomplished. The information obtained will not be reported in detail nor referenced to a specific industrial installation by name.

We urgently request your co-operation in completing the questionnaire and returning it at your earliest convenience. Please feel free to supply such additional information or comments as you may desire.

Your interest and co-operation will be greatly appreciated.

Yours very truly,

R. L. Stockman

ROBERT L. STOCKMAN
Engineer in Charge
Air Pollution Program

RLS:mm

FIGURE 3

FIGURE 11

INTERVIEW DATA SHEET - PART 1

AIR POLLUTION SURVEY
CONNECTICUT STATE DEPARTMENT OF HEALTH
MAY 1956

Town:_____

Persons Interviewed:_____

_____

Date:_____

I. Town description:

1. Estimated population (July 1, 1956) _____
2. Labor force (June 1955) _____
3. Number of manufacturing employees (June 1955) _____
4. Predominant industry _____; number of employees ___ _____
5. Topography _____

II. Remedial action:

1. Legal controls

(a) Air pollution control ordinance: yes _____ no _____

(b) Air pollution control provisions in:

Zoning ordinance: yes _____ no _____ Ordinance not examined _____

Heating ordinance: yes _____ no _____ Ordinance not examined _____

Incinerator ordinance: yes____ no____ Ordinance not examined _____

Pollen control: yes _____ no _____ Ordinance not examined _____

Nuisance regulations: yes____ no____ Ordinance not examined _____

2. Activity

(a) Studies or surveys: date _____ by _____

(b) Complaints received: Number/year _____, none _____

(c) Problems investigated by: H.D., F.D., B.D._____, none _____

(d) Problems investigated by: S.H.D. _____

(e) Time on air pollution: (man months per year) _____

FIGURE 4

FIGURE 12

INTERVIEW DATA SHEET - PART II

III. Problem evaluation

Source of Air Pollution	No. of Prob.	Severity of Problem			Type of Pollution				Heat. Plant	Incin-erator	Sources in other municipalities
		Major	Minor	Neg.	Smoke	Dust	Odor	Fumes			
Total											
Private Homes											
Apartments											
Hotels											
Office Bldg.											
Store											
Bakery											
Laundry											
School											
Hospital											
Incinerator											
Dump											
Vehicle exhaust											
Utility											
INDUSTRY:											
Textile											
Lumber & furn.											
Paper											
Chemical											
Drugs											
Petroleum & Coal											
Rubber											
Leather											
Stone, clay, glass											
Primary metal											
Fabricated metal											
Mining											
Miscellaneous											

FIGURE 4 (CONT'D.)

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(1) McCaldin, R. O., P. A. Konline, Air Pollution in Connecticut, Robert A. Taft Sanitary Engineering Center, Public Health Service, Cincinnati, Ohio, 1957.

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